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Ins B1Machine and Process for Producing a Multi-layered Fibrous Web

Ins B2 The invention relates to a machine for producing a multi-layered fibrous web, in particular a paper or cardboard web, in which the layers created by each former are couched together, i.e., connected. It further concerns a process according to the preamble of claim 26.

A machine and a process of this type are disclosed, for example, in the publications DE 197 04 443 A1, DE 198 03 591 A1, DE 197 33 316 A1, DE 196 51 493 A1, and DE 44 02 273 A1.

Ins B3 Different types of formers are known. For instance, in a fourdrinier former, the dewatering occurs at the wire side. A concentration of fines at the upper side is achieved with power pulses. In a hybrid former, the main dewatering occurs at the wire side. In the zone of the upper wire, the dewatering occurs at the top which results in a reduction of the content of fines at the top. In a so-called roll blade gap former the dewatering occurs first at the top and then at the bottom, which results in a higher content of fines at the bottom.

In the paper machines known from DE 197 04 443 A1 and DE 44 02 273 A1, combinations of two or more gap formers are used.

Embodiments of gap formers for packaging can be found, for instance, in publications DE 198 03 591 A1 (Duo Former Base) and DE 196 51 493 A1 (Duo Former Top). In the wire section described in DE 196 51 493 A1 the fibrous layer formed by the gap former and a first fibrous layer, introduced by a continuous belt, are couched together at their upper wire sides that are low in fines. The flow direction of the headbox associated with the gap former is the same as the travel direction of the continuous belt introducing the first fibrous layer.

This has the disadvantage, however, that the fibrous layers couched together at their sides with a low content of fines have poor layer adhesion.

sub B4 5 It is the object of the invention to create an improved process as well as an improved device of the above mentioned kind in which better layer adhesion is ensured in an economical and reliable fashion.

10 This object is obtained concerning the paper machine in that at least two layers, which are to be couched together and each have on one side a higher content of fines, are guided to the applicable couching zones in such a way that the sides having the higher content of fines come into contact with each other and in that at least one of the two 15 layers was created by a gap former.

20 This embodiment results in a number of relevant advantages in practical operation, for instance, better layer adhesion, higher retention, a lower risk of so-called "sheet-sealing" effects, less residue during dewatering, less dusting, as well as a positive influence on the paper characteristics concerning porosity, roughness, penetration 25 characteristics, and printability.

20 In a preferred practical embodiment according to the invention, at least one of the two layers is created by a gap former that contains two circulating continuous dewatering belts which converge forming a headbox nip and which, in the area of this headbox nip loaded by a headbox with a fibrous suspension, are guided by a forming element such as, in particular, a forming roll or the like. At least one of the two dewatering belts can be 25 provided, in particular, as a dewatering wire.

30 In an advantageous practical embodiment according to the invention, each of the two layers is formed by a gap former. The sheet formation of the two layers each occurs with a higher content of fines at the forming element side. The web travel directions of the two gap formers are preferably opposite to each other. In this context, in particular,

such embodiments are conceivable in which the layer formed in the first gap former is converged with at least one of the two dewatering belts around a deflection element, such as, in particular, a deflection roll or the like, and then introduced into the corresponding couching zone via a continuous belt in a direction generally opposite to the flow direction of the first headbox, in which the layers created by the two gap formers are couched together at the sides with the higher content of fines.

Here, for instance, the layer created in the first gap former can be guided around the deflection element together with the outer dewatering belt, which does not come into contact with the forming element, and be introduced into the couching zone via this outer dewatering belt. Preferably, both dewatering belts are guided around the deflection element and, after having passed this deflection element, the inner dewatering belt is separated from the outer dewatering belt which entrains the layer. It is useful to guide the outer dewatering belt of the first gap former following the deflection element in a generally horizontal direction, at least up to the area of the couching zone.

However, another embodiment is conceivable, for instance, in which an additional layer is created by an endless wire former and the formation of the sheets of this layer occurs with a higher content of fines on the outer side facing away from the endless wire, while the layer created in the first gap former and guided over the deflection element is couched together with the layer created by the endless wire, and these two layers are introduced via the endless wire into the couching zone in which the layers formed in the two gap formers are couched together with their sides with higher contents of fines. In this connection it is advantageous for the outer dewatering belt of the first gap former in the web travel direction to be separated from the inner dewatering belt and the relevant layer before the deflection element, and for only the layer in question to be guided around the deflection element together with the inner dewatering belt. The layer created in the endless wire former and the layer created in the first gap former are preferably couched together in the area of the deflection element and/or of a couching roller.

After the separation of the two relating dewatering belts of the second gap former, the layer created by the second gap former can be introduced into the couching zone together with the outer dewatering belt in which the two layers created in the gap formers are couched together with their sides with a higher content of fines.

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An alternative embodiment of the machine according to the invention is characterized in that one of the two layers couched together with their sides containing a higher content of fines is created by an endless wire former and the sheet formation of this first layer occurs with a higher content of fines on the outer side facing away from the endless wire and that the second layer is created by a gap former and the sheet formation of this second layer occurs with a higher content of fines on the forming element side.

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In this connection, the flow direction of the headbox associated with the gap former advantageously corresponds generally to the travel direction of the first layer created by the endless wire former. The layer created by the gap former is preferably introduced after the separation of the two dewatering belts of the gap formers, together with the outer dewatering belt to the couching zone in which it converges for couching together the two layers with the endless wire. Preferably, the endless wire can be guided in a generally horizontal manner at least in the area of the couching zone.

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At least one additional gap former is provided in a practical embodiment in which the sheet formation of the allocated additional layers with higher content of fines occurs at the forming element side. The additional layer is couched together with the layer created by the first gap former in an additional couching zone. The flow direction of the headbox associated with the additional gap former preferably corresponds to the travel direction of the layer created by the endless wire former.

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In a practical manner, after a separation of the two dewatering belts of the additional gap former the additional layer created by the additional gap former is

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introduced together with the outer dewatering belt of the additional couching zone in which it converges for couching together with the two layers formed by gap formers. Preferably, the endless wire is guided in generally horizontal fashion, at least in the area of the two couching zones.

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For the formation of an at least three-layer to four-layer fibrous web, at least one additional gap former can be provided wherein the sheet formation of the additional layer occurs with a higher content of fines occurs at the forming element side. The additional layer is couched together with the layer created by the preceding gap former in an additional couching zone so that at least one of the two layers with a side having a higher content of fines is couched together with the other layer. The stream direction of the headbox associated with the additional gap former preferably is the same as the flow direction of the fibrous web to be formed.

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15 A multi-layer headbox and/or a single-layer headbox and/or any combination of various headboxes can each be provided as headbox.

Uniform pressure dewatering elements can be provided for dewatering the fibrous web, if necessary. They can be embodied, for instance, like the one described in DE 197

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33 316 A1.

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The process according to the invention is accordingly characterized in that at least two layers to be couched together each with one side having a higher content of fines, are introduced into the relevant couching zone in such a way that their sides with a higher content of fines are in contact with one another, and in that at least one of the two layers is created by a gap former.

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*3.5 B5* Advantageous embodiments of the process according to the invention are listed in the subclaims.

~~The invention shall be described in detail below using exemplary embodiments with reference to the drawings, which show:~~

5 Fig. 1 a schematic representation of an embodiment of a machine for producing a multi-layered fibrous web in which both layers to be couched together on their sides with a higher content of fines are each formed by gap formers,

10 Fig. 2 a schematic representation of another embodiment of the machine in which both sides to be couched together on their sides with a higher content of fines are formed by a gap former, in which another, first layer is formed by an endless wire former

15 Fig. 3 a schematic representation of another embodiment of the machine in which the first of the two layers to be couched together on their sides with a higher content of fines is formed by an endless wire former and the second layer is formed by a gap former.

20 Fig. 4 a schematic representation of another embodiment of the machine comparable to the one in Fig. 3 in which another gap former is provided for the formation of another layer, here third, layer, and

25 Fig. 5 a schematic representation of another embodiment, using that of Fig. 2 solely by way of example in which an additional gap former is provided for the formation of an additional layer, here fourth, layer.

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Figs. 1 through 5 depict various embodiment of a machine for producing a multi-layered fibrous web, in particular a paper or cardboard web, in which the layers formed by each former are couched together, i.e., are connected.

30 The various embodiments have in common that each of the two layers to be

couched together, each having a higher content of fines on one side, are guided to the corresponding couching zone in such a way that they come into contact with each other on their sides with a higher contact of fines and that at least one of these two layers was created by a gap former.

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Fig. 1 depicts a machine for producing a two-layer fibrous web in which each of the two layers A, B is created by a gap former 10 and 12.

The gap formers 10, 12 each contain two circulating endless dewatering belts 14, 10 16 or 14', 16', which converge, forming a headbox nip 18 or 18' and which are guided in the area of this headbox nip over a forming element, here a forming roll 20 or 20'. The outer dewatering belt 16 is guided to the forming roll 20 over a breast roll 22. Each headbox nip 18, 18' is loaded with fibrous suspension by a headbox 24 or 24'. Inside the loop of the outer dewatering belt 16, 16', a forming shoe 26 or 26' is provided 15 immediately adjacent to the forming roll 20, 20'.

In the present case, layer A is formed by the gap former 10 and layer B by the gap former 12. The sheet formation of each of the two layers A, B occurs with a higher content of fines on the forming element side, i.e., here on the side of the forming roll 20, 20'. 20

As is discernible from Fig. 1, the belt travel directions L of the two gap formers 10, 12 and the stream directions of the headboxes 24, 24' associated therewith are in 25 opposite to one another.

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The layer A formed in the first gap former 10 is guided around a deflection element, here a deflection roll 28, together with the two dewatering belts 14, 16 behind the forming roll 20 in web the travel direction L and then introduced into the couching zone 30, via the outer dewatering belt 16 in a direction opposite to the general stream 30 direction of the first headbox 24, in which the layers A, B formed by the gap formers 10,

12 are couched together at their sides with a higher content of fines. The relative distribution of fines is also depicted symbolically again in Fig. 1 at the right side.

5        Immediately behind the deflecting roll 28 the inner dewatering belt 14 is again separated from the outer dewatering belt 16 entraining the layer A.

10        Starting from the deflecting roll 28 the outer dewatering belt 16 of the first gap former 10 is guided in generally horizontal direction beyond the couching zone 30. From here, this outer dewatering belt 16 is guided back to the first gap former 10.

15        After the separation of the two dewatering belts 14', 16' of the second gap former 12, the layer B formed by the second gap former 12 is introduced together with the outer dewatering belt 16' into the couching zone 30, in which the two layers A, B formed in the gap formers 10, 12 are couched together with their sides of higher content of fines. In the area of the couching zone 30, the outer wire belt 16', that entrains the layer B is guided over a couching roll 32.

20        Fig. 2 depicts an embodiment of a machine for producing a three-layered fibrous web. Here, the first layer A is formed by an endless wire former 34 in which the sheet formation of the layer A occurs with a higher content of fines on the outer side facing away from the endless wire 36. The second layer B and the third layer C are each formed by a gap former 10 or 12.

25        The layer B formed in the first gap former 10 and guided over the deflection roll 28 is couched together with the first layer A formed by the endless wire former 34 in the area of this deflection roll 28. Then the two connected layers A and B are introduced by the endless wire 36 into the couching zone 30 where the two layers B, C formed by the two gap formers 10, 12 are couched together at their sides with a higher content of fines. Again, the resulting distribution of fines is depicted symbolically in Fig. 2 at the right side.

As can be seen in Fig. 2, in the present case the outer dewatering belt 16 of the first gap former 10 is separated from the inner dewatering belt 14 and the relevant layer B in front of the deflection roll 28 in the web travel direction L. Accordingly, this layer B is guided here only together with the inner dewatering belt 14 around the deflection roll 28. Then, in the area of the deflection roll 28, the first layer A formed in the endless wire former 34 and the second layer B formed in the first gap former 10 are couched together.

The layer C formed by the second gap former 12 is introduced into the couching zone 30 after a separation of the two dewatering belts 14', 16' of the second gap former together with the outer dewatering belt 16', in which zone the two layers B, C formed in the gap formers 10, 12 are then couched together at their sides with a higher content of fines.

As opposed to the embodiment according to Fig. 1, here the layer formed by the first gap former 10, i.e., here the layer B, is not introduced into the couching zone 30 by the outer belt of the first gap former 10 but rather by the endless wire 36, upon which previously another layer, i.e., the first layer A, had already been formed. The design as well as the relative position of the two gap formers 10, 12 is generally equivalent to the embodiment according to Fig. 1 in which related parts were assigned the same reference characters. The couching of the two layers B, C formed by the gap formers 10, 12 can occur in an area of a couching roll 32 wrapped by the outer dewatering belt 16' of the second gap former 12.

Fig. 3 depicts in a schematic representation another embodiment of a machine for the production of a multi-layered, here again two-layered, fibrous web. In this case the first layer A of the two layers A, B to be couched together at their sides of higher content of fines is formed by a continuous wire 38. Here, the sheet formation of this first layer A occurs with a higher content of fines on the side facing away from the continuous wire 40. The second layer B is formed by a gap former 12 whose design corresponds to that of the second gap former 12 of the embodiment according to Fig. 1. The sheet formation

of the second layer B again occurs with a higher content of fines on the forming element side, i.e., on the side of the forming roll 20'.

5 The stream direction of the headbox 24' associated with the gap former 12 corresponds in general to the web travel direction LA of the first layer A formed by the fourdrinier former 38.

10 The layer A formed by the gap former 12 is introduced into the couching zone 30 after the separation of the two dewatering belts 14', 16' of the gap former together with the outer dewatering belt 16', in which zone it is brought together with the continuous wire 40 for the couching of the two layers A, B with their sides of higher content of fines. 15 The resulting distribution of fines is depicted symbolically in Fig. 3 at the right side.

15 As discernible in Fig. 3 the continuous wire 40 is guided in general horizontally from the correlating headbox 42 beyond the couching zone 30.

20 The embodiment depicted in Fig. 4 is different from the one in Fig. 3 in that another gap former 44 is provided for the creation of a three-layered fibrous web. In the present case, this gap former corresponds in both design and orientation to the gap former 12 that forms the second layer B. The sheet formation of the third layer C again occurs with the higher content of fines on the forming element side.

25 The third layer C and the second layer B formed by the preceding gap former 12 are couched together with their sides of higher content of fines in another couching zone 46.

30 The stream direction of the headbox 48 associated with the additional gap former 44 corresponds to the travel direction LA of the first layer A formed by the fourdrinier former 38. The third layer C formed by the additional gap former 44 is guided, after the separation of the two dewatering belts 50, 52 of the additional gap former 44, together

with the outer dewatering belt 52 to the additional couching zone 46, in which it is brought together with the continuous wire 40 in order to couch together the two layers B, C formed by the gap formers 12, 44.

5        The continuous wire 40 is guided beginning at the headbox 42 of the fourdrinier former 38 past the first couching zone 30 as well as past the second couching zone 46 in general horizontally and then it is guided back to the headbox 42 via deflection rolls.

10       Fig. 5 depicts schematically another embodiment, only by way of example based on Fig. 2, in which an additional gap former 54 is provided for the formation of another, here fourth, layer D. In the present case, this additional gap former 54 is positioned behind the two provided gap formers 10, 12 in the machine travel direction according to the embodiment of Fig. 2.

15       The sheet formation of the additional layer D occurs with a higher content of fines on the forming element side.

20       The design and orientation of the additional gap former 54 correlate in the present case to those of the preceding gap formers 12 that form the third layer C.

25       The fourth layer D is couched together with the third layer C formed by the preceding gap former 12 in an additional couching zone 56, in which at least one of the two layers C, D, in the present case the fourth layer D, is couched together with the other layer at a side with a higher content of fines.

30       The flow direction of the headbox 58 associated with the additional gap former 54 is the same as the travel direction of the fibrous web being formed, i.e., in the present case, the travel direction LA of the first layer A formed by the fourdrinier former 34.

Such an arrangement avoids the couching together of two sides with lower

content of fines in the case of an additional layer D.

The resulting distribution of fines is depicted symbolically on the right side of Fig. 5. Generally, additional gap formers are possible as well.

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As discernible from Fig. 5 the continuous wire 36 is guided essentially in a horizontal direction beginning at the headbox of the fourdrinier former 34 over the first couching zone provided in the area of the deflection roll 28 of the gap former 10 as well as over the couching zone 30, in which the layers B and C are couched together with their sides having a higher content of fines, and beyond the additional couching zone 56. 10 Then the continuous wire 36 is guided back to the headbox of the fourdrinier former 34. The present embodiment has the same design as the one of Fig. 2 in other respects as well.

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The extension with at least one gap former, depicted in Fig. 5 for instance, is also possible in the preceding embodiments.

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In all cases the headboxes can be provided as multi-layered headboxes or as single-layered headboxes.

If necessary, uniform pressure dewatering elements can be used for dewatering the fibrous web. They can be designed, for instance, such as the ones described in DE 197 33 316 A1.

10	Gap former
12	Gap former
5	14 Inner dewatering belt
	14' Inner dewatering belt
	16 Outer dewatering belt
	16' Outer dewatering belt
	18 Headbox nip
10	18' Headbox nip
	20 Forming roll
	20' Forming roll
	22 Breast roll
	22' Breast roll
15	24 Headbox
	24' Headbox
	26 Forming shoe
	26' Forming shoe
	28 Deflection roll
20	30 Couching zone
	32 Couching roll
	34 Fourdrinier former
	36 Continuous wire
	38 Fourdrinier former
25	40 Continuous wire
	42 Headbox
	44 Additional gap former
	46 Couching zone
	48 Headbox
30	50 Inner dewatering belt

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52 Outer dewatering belt  
54 Additional gap former  
56 Additional couching zone  
58 Headbox

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A Layer  
B Layer  
C Layer  
D Layer

10 L Web travel direction

LA Travel direction of the first layer

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